Air Plus Service Manual

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1. Purpose and function of product

- The Air Plus is designed to prevent and treat pressure sores in high / very high risk patients. As with all alternating mattress systems, the Air Plus is contra indicated for use where patients have unstable fractures or spinal injuries.
- It is suitable for use in hospitals, nursing homes and in the community.
- The Air Plus gives gentle, dynamic support to bedridden and immobile people in recumbent and supine postures. This support is provided by a specially constructed single layer mattress which is comprised of a series of transverse, air filled, cells that are alternately inflated and deflated. Separate, permanently inflated side formers provide enhanced patient security.
- An optional 40mm thick foam mattress that can be inserted into a pocket beneath the alternating air cells enables it to be used as a mattress replacement if so desired.
- Air to inflate the Mattress is supplied by a microprocessor controlled Power Unit.
- The Mattress is connected to the Power Unit by an umbilical, which incorporates an emergency deflation valve to allow cardiac resuscitation procedures, and also self-sealing valves, which allow the Mattress to remain inflated when disconnected. A separate quick-connect valve allows for independent deflation of the side formers to make it easier for patients getting on or off the Mattress.
- A solid-state pressure sensor continuously monitors the pressure in the Mattress and the system is completely self-regulating.
- Operator controls are deliberately minimised.
- Audio and visual alarms are activated if the mains supply is disconnected, the Mattress is not fully inflated within 60 minutes of being initially switched on or if the Mattress pressure is too low or too high. Appropriate warning displays are shown on the display panel.

2. Construction of product

The product consists of two major elements:

2.1. Mattress

- The Mattress consists of a single layer of 17 inflatable air cells arranged transversely between 2 longitudinal inflatable formers. The cells and formers are manufactured from PU coated nylon. With the exception of the head end cell the transverse air cells are connected so as to inflate alternately. The side formers and head cell remain continuously inflated and serve to provide an air reservoir, the pressure of which is monitored and maintained by the control system.
- The air cells are housed in a cover consisting of a base and a removable zipped cover sheet. A separate pocket in the base provides the facility to insert an optional 40mm thick foam mattress for additional protection. The PU coated nylon base is provided with restraining straps to securely locate and retain the Mattress on the bed. The washable cover sheet is made from a two-way stretch, breathable, waterproof material that protects the Mattress as a whole from soiling by body fluids.

2.2. Power Unit

The Power Unit consists of the following major elements:

- Case and Control Panel
- Air compressor
- PCB Assembly
- Solenoid Valves

2.2.1. Case and Control Panel

The case is consists of two high impact polystyrene fabrications locked together by 6 pozi head screws. The case is provided with rubber buffer pads that protect both the case and bed footboard. Two adjustable mounting hooks are fitted at the rear of the case.

An integral membrane switch panel is bonded to the recessed sloping front panel. Except for the mains on/off switch this panel contains all the functional controls and operational displays.

A rocker action mains on/off switch is mounted on the sidewall of the rear body. This switch contains an integral green LED to indicate that the unit is switched on.

A label bearing the unit serial number, type classification and electrical rating information is affixed to the rear of the case.

2.2.2. Air Compressor

The compressor is essentially a small plastic bodied linear electric motor – the armature of which reciprocates to displace flexible diaphragms, which create the air delivery.

The compressor draws air directly from within the Power Unit casing and delivers it via 5mm bore silicone tubing to a filter/silencer that also acts as a reservoir and so helps to smooth out pressure fluctuations in the delivery system.

The compressor has rubber mounted feet attached by screws to a mounting plate that is bonded, via a flexible foam pad, to the inside of the case. This minimises the transmission of vibrations and noise. The compressor has flying leads fitted to a special plug for connection to the PCB.

2.2.3. PCB Assembly

The PCB is mounted on the rear of the casing front cover. It is connected directly to the mains supply lead and the on/off switch and also to the pneumatic circuit via a 3mm bore silicone tube.

The PCB carries both the power supply and control system circuitry. The major components are the fuse holders (1 amp), mains transformer, solid state relay for the mains voltage compressor, rechargeable battery, controlling microprocessor, display LEDs, pressure sensor and the audible alarm sounder.

2.2.4. Solenoid Valves

Pneumatic control of the system is achieved through the use of 2 off 3-way valves, see pneumatic circuit diagram. The 12 volt d.c. valves incorporate a quietened action. The valves are fitted with push-on plastic tubing adapters and are interconnected with 6mm bore silicone rubber tubing.

3. Performance of the Product

3.1. How the Product works

3.1.1. Introduction

The objective of the product is to relieve the pressure created under a patient when lying on a bed, so that blood flow is maintained and tissue oxygenation achieved. It does this by intermittently relieving pressure from the patient by alternately deflating the cells in the inflated mattress. The power unit provides the source of energy to achieve this and also the necessary monitoring and control systems for efficient and safe operation.

In simple terms the air compressor delivers air to the solenoid valves controlling the flow of air into and out of the mattress cells. The air pressure within the mattress is continuously monitored by the solid-state pressure sensor, enabling the inflation pressure to be directly controlled.

The software based control system operates the valves enabling air to flow into, or out, of the air cells as required according to the operating mode selected. It also maintains the pressure within the air cells at the required level and controls the action of the alarm system in the event of mains supply failure, over or under inflation of the mattress or electrical failure of one of the valves.

3.1.2. Start Up

When the power unit is switched on the compressor starts running. Air is delivered to valves A & B and hence to both sets of interconnected cells in the mattress. Air also flows directly into the inflatable side formers and the air cell at the head end of the mattress. The LED display is illuminated and flashes 3 green horizontal bars '_ _ _' followed by 3 green zeros '0 0 0' as the mattress inflates.

3.1.3. Dynamic Mode

Once the mattress is fully inflated the power unit automatically switches into the 'Dynamic' mode and the display changes to alternately flash ' _ 0 _' and ' 0 _ 0' in green. Valve A is energised for 3 minutes allowing air in the A cells to vent to atmosphere. During this period the compressor is switched off. Valve A is then de-energised, the compressor is switched on and in the next 2 minutes the A cells are re-inflated to the working pressure and maintained there. The process is then repeated for the B cells so that the whole cycle repeats every 10 minutes.

3.1.4. Static Mode

The 'Static' mode, in which all the cells remain inflated, is selected by pressing the 'Mode' switch on the control panel. The LED display changes to '0 0 0' and blinks every few seconds as an indication that the system is operating correctly. In this mode both the A and B valves are de-energised and the compressor only runs when it is necessary initially to achieve the pre-set pressure or to compensate for air leaks, etc. If the user has not already changed the mode, the 'Static' mode is automatically limited to a maximum time of 2 hours, after which for reasons of clinical safety, operation reverts to the 'Dynamic' mode.

3.1.5. Comfort (Program)

Systems fitted with Version 2 Software incorporate a 'Comfort' feature that enables the Mattress pressure to be reduced to provide a softer support surface.

To select the 'soft' setting from the standard 'Dynamic' mode press the 'Mode' switch on the control panel twice. The display changes to alternately flash 'o-o' and '-o-' indicating 'Dynamic' operation at the lower 'soft' pressure.

Pressing the 'Mode' switch again switches the system into the low pressure 'Static' mode and the display flashes 'ooo'.

Pressing the 'Mode' switch again switches the system back into normal 'Dynamic' operation.

3.1.6. CPR Deflation

The CPR Valve consists of a manually operated rotary action valve incorporating 3 individual, large bore, spring loaded dump valves that, when opened, connect all the air cells to atmosphere and hence allow rapid mattress

deflation. For convenience and accessibility the CPR valve is mounted in the umbilical between the mattress and the power unit.

Rotating the red operating knob clockwise to the 'CPR' position opens the valve. As the mattress deflates the 'Low Pressure' alarm will be activated and should be cancelled by switching the power unit off.

3.2. Installation

3.2.1. Installation of the mattress

Remove the bedding from the conventional mattress.

Place the Air Plus Mattress onto the bed platform ensuring that the removable waterproof cover is on top and that the umbilical hose is at the foot end of the bed. Secure the mattress to the bed by fastening the two head end straps to the head section of the bed and its mid-position and foot-end straps around the foot section of the bed. The straps should not be too tight and should not interfere with the operation of the bed. They should be checked regularly and must be attached to the moving parts only.

Note: Where the Air Plus mattress is supplied with its integral foam insert it may be used as a replacement mattress. In this circumstance remove the conventional mattress and make sure that the bed base is free of pointed or sharp objects to avoid damaging the mattress.

Cover the mattress with a loose fitting sheet.

3.2.2. Installation of the Power Unit.

Hang the power unit onto the bed footboard using the integral hooks. Connect the umbilical hose to the power unit by inserting the 3 male probes into the female quick connect sockets. The head cell/former probe is physically non-interchangeable with the other probes. Correct connection is indicated by an audible 'click'. Check that the CPR valve is turned to the 'Normal' position.

3.2.3. Switch On

Insert the mains plug into a suitable 230-volt socket. Switch on the power unit using the on/off switch located on the side of the case. The LED display will indicate '_ _ ' and '0 0 0' alternately in green showing that the mattress is filling with air. Once the operating pressure is reached the system switches into 'Dynamic' mode and the display alternately indicates '_ 0 _' and '0 _ 0' in green. The 'Static' mode can be selected at any time by pressing the mode switch on the control panel.

Note: Although the patient can be positioned at any time, it is preferable that this is done with the 'Static' mode selected since this ensures a stable surface.

4. Maintenance Procedures

4.1. Safety

Only qualified technicians trained or formally approved by DHS Ltd. in the operation and maintenance of DHS products may carry out maintenance, modification or repair work on DHS Power Units.

Unqualified personnel attempting to work on DHS Power Units risk serious injury to themselves and others, and possibly death by electrocution.

4.2. Cleaning Procedures

WARNING!

Before cleaning the System make sure that the Power Unit is disconnected from the mains electricity supply.

Do not immerse the Power Unit in water or other fluids.

Do not autoclave, nor use Phenol for cleaning.

Do wash hands before commencing the cleaning process. Don appropriate protective clothing such as gloves, an apron and a mask. Ensure all work surfaces are cleaned before and after contact with the mattress.

4.2.1. Cleaning the Mattress

1. With the Cover left on, disconnect the Mattress from the Power Unit.
2. Clean the surface of the wash down table with Hypochlorite solution or equivalent disinfectant.
3. Wash Mattress top using warm water (60 degrees C) containing detergent – dry with a paper towel.
4. Fold Mattress in half, from head to foot end, clean table and the exposed half of Mattress. Dry with a paper towel.
5. Invert folded Mattress to top half of table, clean table and exposed half of Mattress. Dry with paper towel.
6. Repeat steps 3 to 5 using Hyperchlorite solution 1,000 parts per million available chlorine.
7. Using a suitable brush, hot water, detergent and Hyperchlorite solution, clean the Umbilical Hose and CPR Valve. Dry with paper towel.
8. If required, the Mattress Cover may be removed and machine-washed at a temperature of 90 degrees C, for not less than 10 minutes. The individual Air Cells can be wiped down with established disinfectants.
9. The Mattress Cover may be sterilised using ETO or Draeger processes.

4.2.2. Cleaning the Power Unit

The Power Unit can be cleaned by wiping down with a cloth dampened with a detergent solution, Hypochlorite solution or by sterilising using ETO or Draeger processes.

4.3. Routine Maintenance Procedures

Note:

- It is recommended that the Air Plus be part of a planned preventive maintenance programme.
- To prevent damage, normal electrostatic control procedures must be observed when working on the Power Unit.
- Electrical safety checks must be carried out on completion of any repair or routine maintenance.

4.3.1. Power Unit – General

1. Gain access by removing the 6 off M3 screws retaining the front cover.

2. Remove any accumulation of dust from inside and outside of the unit, using a small portable vacuum cleaner or similar.

3. Check the security of the wiring, the tightness of screws and the integrity of component mounting – rectify as necessary.

4. Connect the Power Unit to the mains supply and switch the unit on.

5. Check that the green LED in the on/off switch is illuminated, that the display shows the 'Mattress Inflating' symbols and that the compressor is running.

6. Check all tubing for hardening or cracking – replace as necessary.

7. Check all tubing connections for air leaks – rectify as necessary.

4.3.2. Compressor

Note: The Compressor should be treated as a sealed unit and no servicing or repair is to be undertaken.

1. Remove the inline Air Filter/Silencer and replace.

2. Switch the Power Unit on and check that the free flow output of the Compressor is at least 6 litres/min. If this minimum is not achieved the Compressor should be replaced.

4.3.3. Solenoid Valves

1. Disconnect the A Valve from the PCB and connect it to a switched 12v d.c. supply. Check the action of the Valve as the supply is turned on and off - replace as necessary.

2. Repeat 1. for Valve B.

4.3.4. PCB

1. To prevent damage, normal electrostatic control procedures must be observed when handling or working on the PCB.

2. No repairs can be carried out on-site. In the event of suspected faults the PCB must be replaced and returned for repair.

4.3.5. Mattress

1. Visually Mattress, CPR Valve and Umbilical for obvious signs of wear or damage.

2. Connect the Mattress to the Power Unit and run the system.

3. Check the Mattress, CPR Valve and Umbilical for any leaks, particularly at tubing connections, and rectify as necessary.

4. Check the action of the CPR Valve and rectify as necessary.

4.4. Operation

1. Connect the Mattress to the Power Unit. Switch on and check that the display shows the 'mattress inflating' symbols, see 3.1.2 and that the Mattress is actually inflating.

2. Check that the Power Unit switches into the 'Dynamic' mode at 42mm Hg and that the display shows the appropriate symbols, see 3.1.3.

3. Check that the 'A' and 'B' cells are deflated and inflated alternately.

4. Select the ‘Static’ mode. Check that all the cells are inflated and that the display shows the appropriate symbols, see 3.1.4.

5. Open the CPR Valve and allow the Mattress to deflate. Check that the ‘Low Pressure’ audio/visual alarms are activated and that the display flashes the ‘_ _ _’ symbols in red. Close the CPR Valve, cancel the alarms by switching the unit off and then switch it back on.

6. Disconnect the Power Unit from the mains supply. Check that the audio/visual alarms are activated.

7. Failure of the System to comply with any of the requirements of paras 1 – 6 must be investigated and, where possible, corrected on-site. Where this cannot be achieved the Power Unit and/or Mattress must be returned for repair to the manufacturer or their approved distributor.

5. Technical Data

5.1. General

Air Plus complies with EN60601-1: 1990 + A1: 1993.

5.2. Power Unit

Serial Number	On rear Label
Electrical Supply	230 volt, 50 Hz
Power Consumption	Max – 20 watts
Fuses	2 x 1 amp (internal)
Protection against shock	Class II
Class of Equipment	Class B
Noise Level	Approx. 30 dB (A)
Dimensions	30 x 22 x 10 cm
Weight	2.5 kg
Service Interval	12 months

5.3. Mattress

Serial Number	Internal, at foot end
Number of Air Cells	17 (16 active, 1 static head cell)
Dimensions	200 x 85 x 12 (16 with foam) cm
Weight	5.5 kg

6. Help line

Should you require any further information or assistance with regard to the maintenance or repair of the Air Plus, please telephone 0845 459 9831, and our Service Department will be pleased to help.

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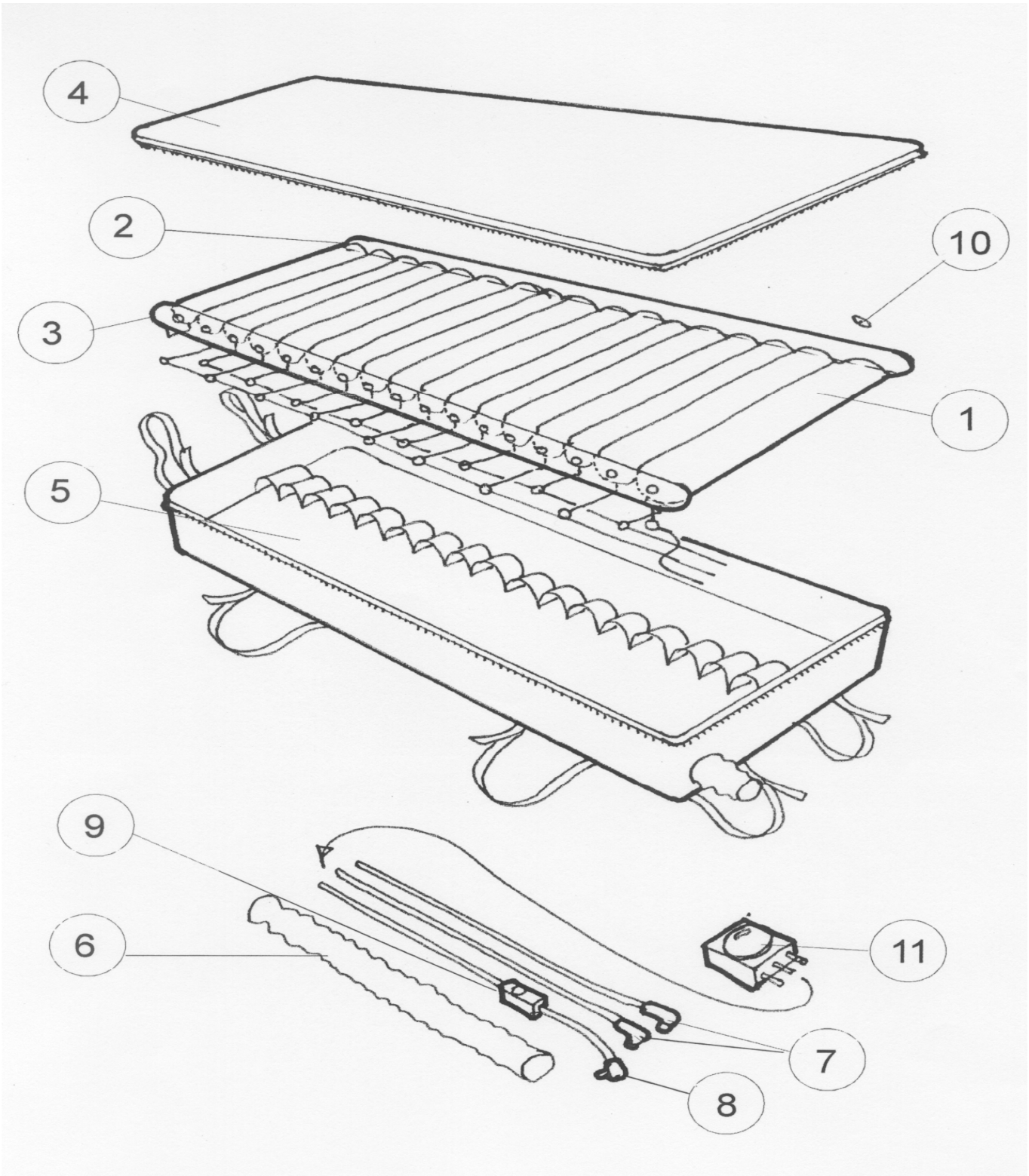

Figure 7.1 Mattress – Exploded View

Item	Name	Part No	Notes
1	Air Cell	MA0201	
2	Former (LH)	MA0301	
3	Former (RH)	MA0401	
4	Stretch Cover	MA0501	
5	Base	MA0601	
6	Umbilical Sleeve	MA0701	
7	QC Elbow, Large	MS0801	
8	QC Elbow, Small	MS0901	
9	QC, In-line	MA0801	
10	Toggle	MA0901	
11	CPR Valve Assembly	CPR001E	

Figure 7.2 Mattress – Parts List

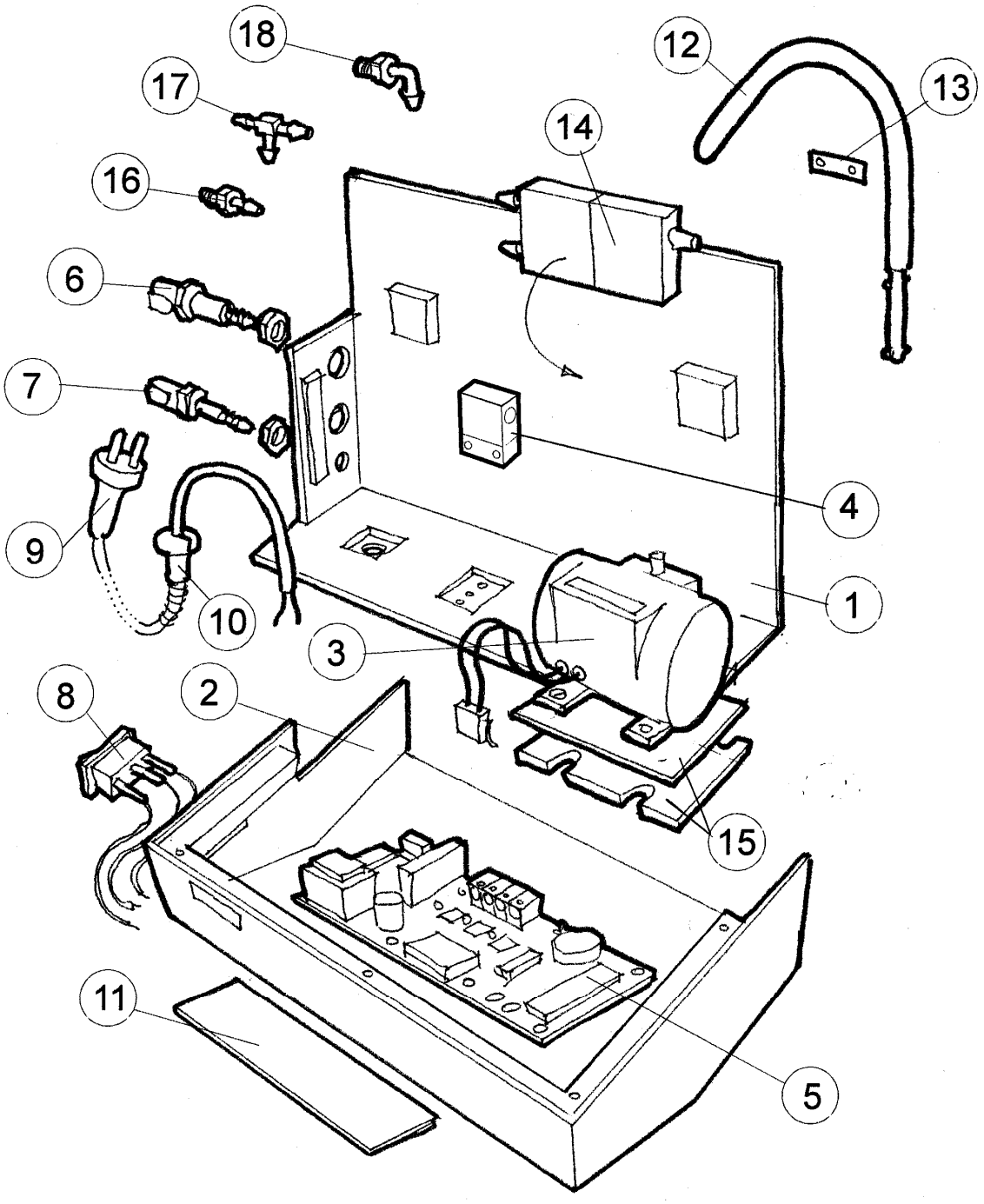

Figure 7.3 Power Unit – Exploded View

Item	Name	Part No	Notes
1	Case Rear	A0201	
2	Case Front	A0301	
3	Compressor	A0401	
4	Solenoid Valve	A0701	
5	Power/Display PCB	A0801	
6	CPC Connector, Large	N2801	
7	CPC Connector, Small	N2901	
8	On/Off Switch	A0901	
9	Mains Cable	N5001	
10	Mains Cable Bush	A1001	
11	Membrane Panel	A1101	
12	Bed Hook	A1201	
13	Clamp Bar	A1301	
14	Silencer	A1401	
15	Compressor Plate Assy.	E2501	
16	Tube Connector	N5401	
17	Pressure Sensor Tee	N5601	
18	Tube Elbow	N5501	

Figure 7.4 Power Unit – Parts List

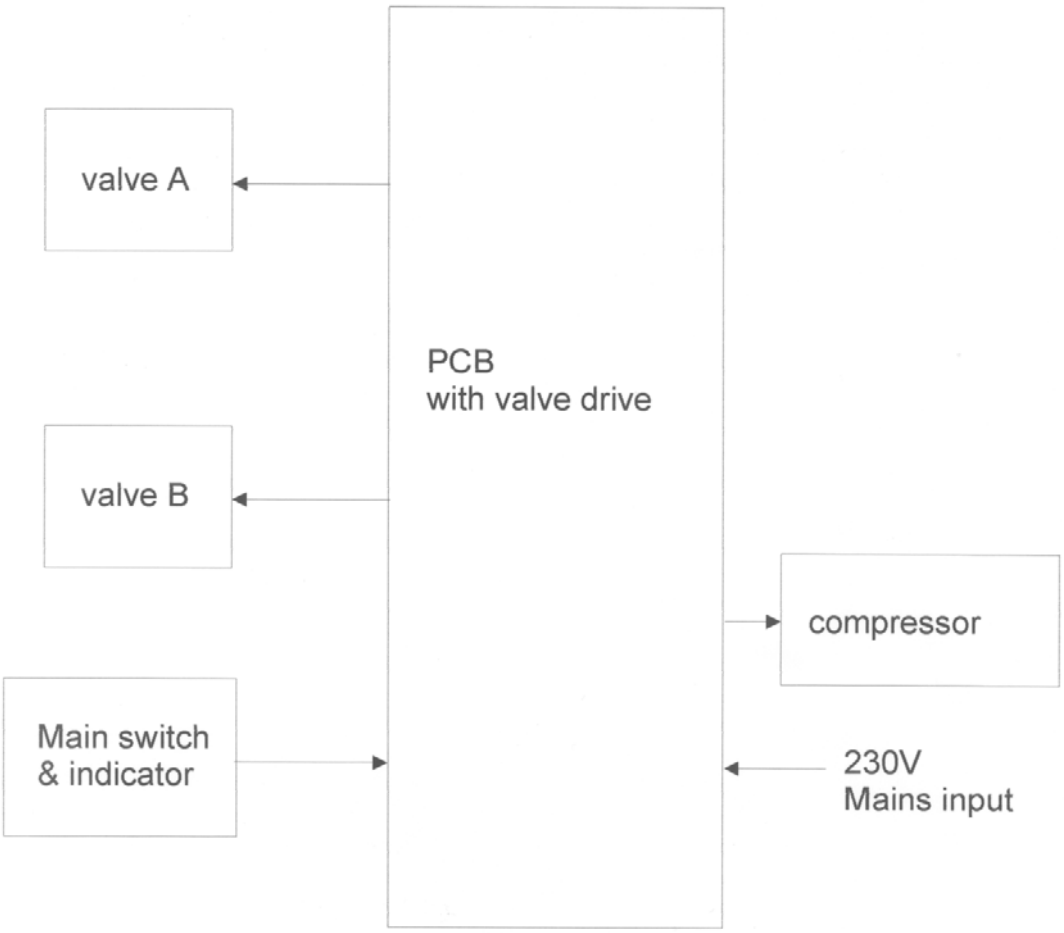

Figure 7.5 Electrical Block Diagram

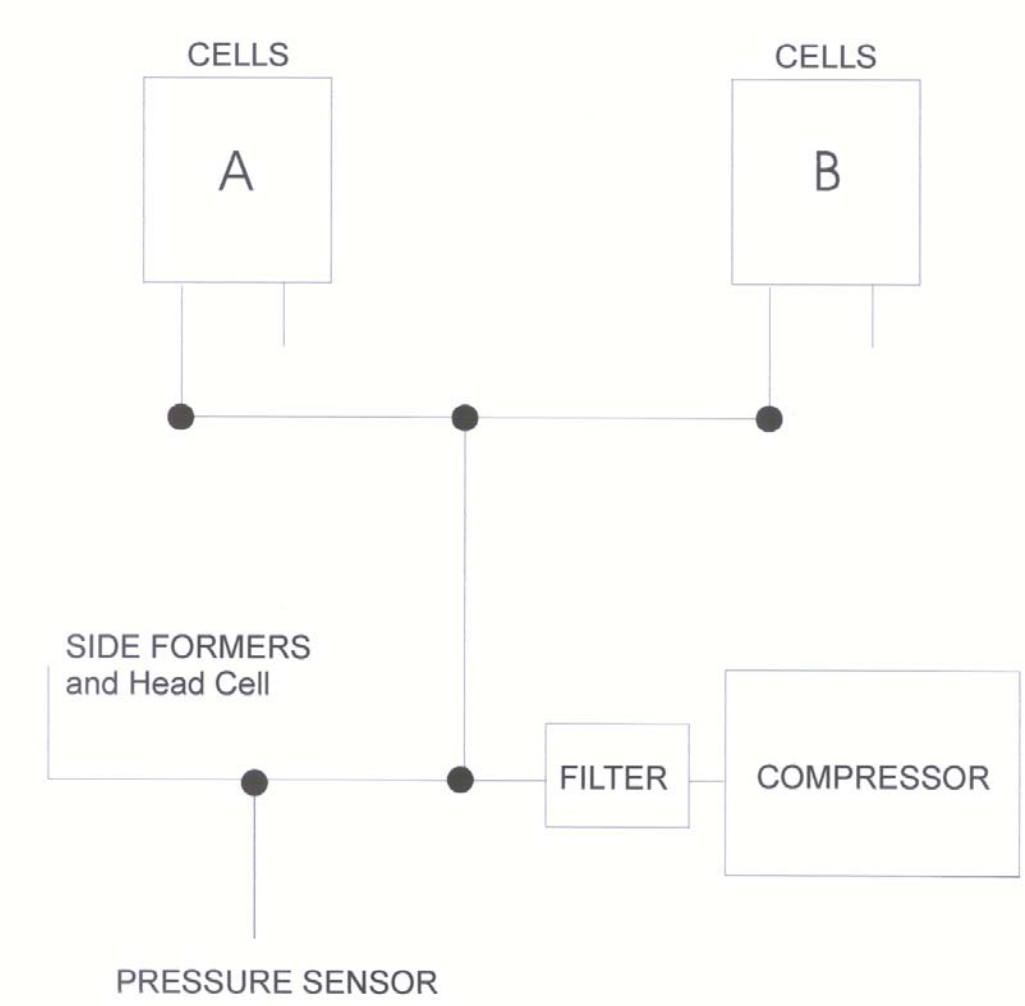

Figure 7.6 Pneumatic Block Diagram

8. Supplier Address

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Products undergo continuous further development. We therefore reserve the right to change the specifications of the product and the warranty conditions without prior notice.

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